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SCIENCE NEWS LETTER

THE WEEKLY SUMMARY OF CURRENT SCIENCE



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on the
Moon.*



SEPTEMBER 12, 1936

Youth on the Moon

See Page 172

A SCIENCE SERVICE PUBLICATION

SCIENCE NEWS LETTER

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The Weekly Summary of



Current Science

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DO YOU KNOW?

Mexico's great estates, that date from old Spanish land-grant days, are being broken up and distributed among the common people.

The Diving Spiders of India dive several inches under water when frightened or when hunting food, and can stay below for more than 20 minutes.

Zinc can now be deposited over steel or iron to protect it with a surface that is brilliant, rather than the well-known dull gray color of ordinary zinc plating.

In 1918, 34 per cent of the Jewish school children in Palestine suffered from trachoma, serious eye-disease; now the disease afflicts less than five per cent.

Citrus wines have been developed by government scientists in Florida.

Nearly one-half of the land and water in the Arctic regions is controlled by the U.S.S.R.

Color of honey has nothing to do with its purity, but the lighter colored honeys are generally milder, and the darker kinds are stronger flavored.

A physician examining Canadian Eskimos was surprised to find nine Eskimos with foreign bodies in the eye, not even aware of an irritating object.

Thorns of the agave or century plant were used as pins and needles by Aztec Indians of Mexico.

Lacking enough land area for extensive sheep raising, Japan is building up an artificial wool industry.

Green glass blackboards are now being made, with the claim that they eliminate glare and lessen eye strain.

Tests show that an automobile that can travel 18 miles on a gallon of gasoline at a speed of 30 miles an hour, will travel only 12 or 13 miles on a gallon at 60 miles.

On his first voyage to the New World, Columbus ascertained his latitude by watching the sun, and using a quadrant and astrolabe.

Nearly 70 per cent of the farm houses in New Hampshire are equipped with electricity, making this state the leader in "electrified farms."

Smoke screens were tried out in battle as early as 50 B.C.

Plants may get badly sunburned if exposed to direct hot sunlight after being kept indoors during the winter; so, it is wise to make the light change gradual.

WITH THE SCIENCES THIS WEEK

Most articles are based on communications to Science Service or papers before meetings, but where published sources are used they are referred to in the article.

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PSYCHOLOGY-PHYSIOLOGY

Why are sounds below 15 cycles in frequency not audible? p. 172.

GENERAL SCIENCE

Galaxy of Scientific Stars Give Their Views at Harvard

Taking Part in Great Tercentenary Celebration, Leaders in Many Fields Address Notable Gathering

Harvard University's Tercentenary Celebration now in progress has brought to Cambridge a group of about 70 of the world's most distinguished scientists from many lands. When the Puritans established a college at Newetowne in 1636, it was the birth of higher education in this country. The intellectual fête commemorating this beginning is reported in some of its highlights by the following articles.

PHYSICS

Sir Arthur Eddington— Relativity Too Artificial

IN HIS own characteristic way Sir Arthur Eddington, noted British astronomer from Cambridge University, England, mildly chided both relativity theory and the quantum theory for artificiality in his address at the Tercentenary Celebration of Harvard University.

Speaking on "The Cosmical Constant and the Recession of the Nebulae," Sir Arthur set up a simple ideal problem in cosmology and attempted to solve it by mathematical attack on the large, or macroscopic scale through relativity and also on the small or microscopic scale through quantum theory.

His intent in doing this, he indicated, was to find some link in meaning between the important constants " K " of gravitation and the cosmical constant " λ " in the relativity theory, and the equally important constants of quantum theory—Planck's constant " h " and the other microscopic constants.

The two answers to his hypothetical problem linking relativity and quantum theory, he said, must agree and should disclose hitherto unrecognized relations between the mutual constants.

Inherent Artificialities

Both quantum theory and relativity theory, Sir Arthur disclosed, have inherent artificialities which make the problem difficult. For example, Sir Arthur said, "We had to catechize the quantum physicist, who writes down a wave equation for two or three particles, as to what he had done with the rest of

the universe. Similarly when the cosmologist treats the curvature of a vacuum (in relativity theory) we have to ask what he has done with the particles removed."

The ideal problem proposed by Sir Arthur for solution was to find the state of equilibrium of a radiationless, self-contained system of a very large number of particles, both positive and negative.

First step in the solution, said the British astronomer, is to obtain the projection of the spherical Einstein universe into a flat space. A spherical space of uniform density throughout, he disclosed, becomes, after projection, a flat sheet with a density distribution concentrated toward the center and fading off to zero at infinity. This distribution resembles the distribution of electron density in the atom of the physicist.

Without following the details of Sir Arthur's mathematics it can be explained that he arrives at a value for the number of particles in his idealized universe problem which he calls a "deputy cosmical constant." To distinguish it from the important cosmical constant λ , Sir Arthur calls it the "cosmical number."

"Precisely"

"I feel satisfied," declared Eddington, "that the cosmical number is precisely $2.136 \cdot 2^{250}$. The number of particles in this Eddington universe would total 2 multiplied by itself 255 times and then multiplied by 272."

From his mathematics Sir Arthur was also able to calculate the limiting maximum speed of recession of the distant nebulae which checks fairly well with observed measurements on the expansion of the universe.

The limiting speed, he declared, is 432 kilometers per second per megaparsec. The first part, 432 kilometers per second is, of course, a velocity amounting to 268 miles a second, or 964,800 miles an hour. A parsec is an astronomical unit of distance equal to 3.26 light years or about 20,000,000,000,000 miles. And a megaparsec is a million parsecs.

What Sir Arthur is saying, therefore, is that for every 20,000,000,000,000,000,000 miles one goes out into space the velocity of recession of the nebulae increases by 964,800 miles an hour.

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PHYSIOLOGY

Prof. Edgar Douglas Adrian— Man Needs Bigger Brain

IF MAN'S life is ever to be lived along entirely rational lines, free from such disturbances as war, crime, and economic booms and depressions, he will have to find a way of increasing the size of his brain.

This is the conclusion to be drawn from what Prof. Edgar Douglas Adrian of Cambridge University, English Nobel laureate and one of the pioneers in "brain wave" investigations, told scientists at the Harvard Tercentenary Celebration of the relation between the nervous system and human behavior.

Scientific delvings into the mechanism of the mind and body, by "brain waves" and other techniques, show that the only certain method by which human behavior can be improved is the apparently impossible feat of breeding men with larger brains.

Tantalizing

"It is tantalizing," Prof. Adrian said, "to think of the new relations we should see, of the new world of thought we should live in, if our brains were but twice their present size. Our behavior would then be superhuman!"

Not even the most fanciful mind, given to picturing a race of supermen in a world to come, could conceive of the result, which Prof. Adrian described as "beyond the power of human thought."

It is unlikely, he said, that neurology, study of the brain and nervous system, will give new methods of control over human behavior, though it will certainly improve some of the methods that already exist, such as the control of behavior by drugs. The new narcotics which "give peace of mind before a surgical operation" show what may be expected in the future from this method of regulating our brains and controlling our behavior.

Studies of the electrical activity that accompanies brain activity, the so-called brain waves, may show what takes place in the brain during the learning process, when new associations are formed in the brain, and why an incentive of an emotional sort is necessary to this proc-

ess. There are definite changes in the electrical activity of different regions, Prof. Adrian pointed out, when we direct our attention from the visual field to the auditory, and vice versa. These are not beyond analysis and ten or even twenty years from now Prof. Adrian believes scientists will know much more about the nerve changes that take place during certain mental processes. The nerve mechanism of consciousness itself, however, will perhaps never be discovered.

Science News Letter, September 12, 1936

ASTRONOMY

Dr. Otto Struve— New Red Nebula

THE great cloud-like patches of light, so spectacular in astronomical photographs and known as diffuse nebulae, are really dust clouds that mirror the light of nearby stars, an astronomical team from Yerkes Observatory, consisting of Drs. Otto Struve, C. T. Elvey and F. E. Roach, has discovered.

Dr. Struve told the scientists at the Tercentenary meeting how he had proved that these nebulae within our own stellar system, the Milky Way, shine by reflected light and consist not of gases but of relatively large aggregates, cosmic dust particles of about one thousand atoms each.

These diffuse nebulae reflect the red light of nearby red stars without change, much as sunlight is often reflected beautifully on a fleecy cloud in another part of the sky. If, instead of a red star, there is a blue star nearby, the mirror-like nebula sends out blue light. This is proof that the particles in the nebula are not small like the gas particles in the earth's atmosphere. On the earth the sky is blue because the layers of atmosphere scatter the blue in the sun's light more effectively than the red wavelengths.

First Result

Dr. Struve's explanation of one of the puzzles of the sky comes as the first result from McDonald Observatory on Mt. Locke, Texas, which is operated jointly by the University of Texas and the University of Chicago. Dr. Struve is director of both Yerkes and McDonald Observatories.

The big telescope for McDonald Observatory is not yet ready for use but this investigation was conducted with a sort of "candid camera" of the sky; the Schmidt camera telescope which has a wide field and very great light-gathering power that allows short exposures.



THE RED NEBULA

A cloud of cosmic dust, reflecting the red light of its neighbor star Antares, is this diffuse nebula (lower center) as photographed by the "photovisual" process at McDonald Observatory. The extent to which the process with its yellow filter brings out the red light of this nebula is realized when comparison is made with a photograph by the ordinary process shown on the facing page.

Because the Schmidt camera is so new in America, Dr. Struve was unable to interest professional lens makers in its construction. The instrument used at McDonald Observatory was the work of the Chicago amateur astronomer, C. H. Nicholson, who now operates the new state police radio station WQPD at Duquoin, Ill.

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ASTRONOMY

Prof. Arthur Haas— Source of Star Energy

A PERPETUAL interchange of energy between light rays everywhere racing through the universe and the shining stars may account for the seemingly endless store of energy in the latter, it was suggested before the gathered scientists at Harvard University's Tercentenary celebration by Prof. Arthur Haas, noted Viennese physicist now at Notre Dame University.

Each photon of light in space, Prof. Haas indicated, loses a "primordial energy-element during each oscillation or in travelling one wave-length."

The loss in radiant energy in the universe, Prof. Haas showed by calculation, is almost identical with the energy production by stars and star-systems. He said: "The energy which is given off in the form of primordial energy-element

might therefore be compensated by the energy production of the stars. Perhaps we might consider the energy which is liberated in the form of primordial energy-elements as the source of the radiation of the star-systems."

The important concept of "primordial energy-element" which is basic in Prof. Haas' statement is one of four "subatomic" constants whose theoretical origin was shown. Declared Prof. Haas:

"The elementary quantum of action may be represented, as is well known, either as a product of energy and time or as a product of length and momentum. If we therefore divide the elementary quantum of action by cosmic constants of the dimensions of time, energy, length and momentum respectively, we obtain four 'subatomic' constants, one for energy, one for time, one for length, and one for momentum. The subatomic energy constant might be called the primordial energy-element."

Also in his discussion, Prof. Haas computed roughly the total mass of all the matter in the universe based on the estimated density of matter in the observable part. The upper limit of mass for a sphere of the observed density would be 10^{57} grams. Thus the matter in the universe weighs in tons approximately the figure 10 with 51 zeros after it. Expressed in terms of the sun's mass, the universe weighs approximately 10^{24} with 24 zeros following.

Science News Letter, September 12, 1936

MATHEMATICS

**Prof. Tullio Levi-Civita—
Extends Relativity Theory**

MORE precise in defining the fundamental law of the universe than even Einstein's general theory of relativity, Prof. Tullio Levi-Civita, mathematical physicist from the University of Rome, announced to Harvard's Tercentenary Celebration new relativistic formulae that apply to two bodies instead of just one as is the case with those of Einstein.

Previous verifications of the general theory of relativity dealt only with gravitational fields due to a single body, Prof. Levi-Civita explained. In the classic case of the advance of the perihelion of the planet Mercury, Einstein considered the field as due to the sun alone, an approximation which is legitimate owing to the smallness of the ratio of the mass of the planet to that of the sun.

But Prof. Levi-Civita now considers the corresponding problem for two bodies of comparable mass as for instance two suns or stars whirling around each other.

His equations show that it is possible to visualize the force exerted as consisting of two parts, one an attraction that acts the way Newton assumed and the other an Einsteinian perturbation. These two together produce an advance of perihelion.

This is not so surprising, he declared, but it is strange that the center of gravity of the motion wobbles slightly instead of being at rest or moving uniformly in a straight line.

Einstein's sensational prediction of the advance of Mercury's perihelion which brought his general theory of relativity into prominence was tested by direct observation. The revision of the Einstein theory that Prof. Levi-Civita suggested cannot be tested upon the planet Mercury with quite so much ease, but Prof. Levi-Civita does expect that astronomers will test it by observations upon double stars which are gigantic systems of twin suns seen as one spot of light in telescopes but capable of being disentangled by their spectra or "rainbows" of light.

Prof. Levi-Civita's solution of the relativistic problem of several bodies will probably be the focus of mathematical and astronomical work for several years to come. The expounder of this new relativistic view is no novice in mathematical physics. He has been a leader in hydrodynamics, theoretical dynamics and pure geometry. His contribution to the theory of absolute differential calculus is credited with helping to lay the foundation for the general theory of gravitational relativity of Einstein. Now, at the age of 63, he is older than Einstein.

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MATHEMATICS

**Prof. Ronald Aylmer Fisher—
Poses Mathematics Problem**

LIKE mathematical problems? Here is one which was given to the learned American Mathematical Society meeting in connection with the Tercentenary celebration of Harvard University by the noted British mathematician, Ronald Aylmer Fisher, professor of eugenics at the University of London.

"The agricultural land of a pre-dynastic Egyptian village is of unequal fertility. Given the height to which the Nile will rise, the fertility of every portion of it is known with exactitude, but the height of the flood affects different parts of the territory unequally. It is required to divide the area, between the several households of the village, so that the yields of the lots assigned to each shall be in predetermined proportions, whatever may be the height to which the river rises."

If mathematicians can solve this problem, said Dr. Fisher, one of the primary problems of what is called mathematically "uncertain inference" will be solved.

Dr. Fisher's invited paper dealt with the history and role of uncertain inference in mathematics. The field is one in which mathematical reason is applied to uncertainties, yet applied with logical rigor.

The problem is one which is being increasingly met in science where it is necessary to take observation data with all their imperfections, their paucity in number and imperfect precision, and yet draw inference from them which the observations warrant.

Lack of this method of uncertain inference, the British mathematician pointed out, is the basis for the old phrase "anything can be proved by statistics."

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PHYSICS

**Dr. W. F. G. Swann—
Discusses Cosmic Rays**

ALL physicists agree that some of the cosmic radiation which strikes the earth's atmosphere from outer space must be electrically charged particles flying at high speeds. But, in the opinion of a number of investigators, those bullets of energy called photons must also play a part.

Speaking at the Harvard Tercentenary Celebration, Dr. W. F. G. Swann of the Bartol Foundation of the Franklin In-



THE BLUE NEBULAE

Ordinary photographic methods bring out the blue nebulae at center and right, but do not indicate the importance of the giant red nebula at the lower center of the photograph. Compare this photograph with that on the facing page.

stitute presented mathematical arguments to the effect that photons are really not at all necessary as primary components. Charged particles suffice to explain everything if only one makes certain assumptions as to the way these particles behave. And Dr. Swann has found, by means of mathematics, just how particles must behave in order that the whole body of cosmic ray facts may be clarified on the particle basis alone.

Little is known of the habits of these fast-flying bits of electricity. Some of the characteristics which Dr. Swann has ascribed to them have been observed in the experiments of other scientists. Other traits with which he has endowed them are entirely original suggestions and have not, as yet, been brought to the test of independent experimental check.

Some of the things which must be true of the electrified particles if they are to constitute the whole cosmic ray story are the following:

1. There must be two kinds of particles.
2. As they pass through matter, both kinds must lose energy at a rate which increases as the energy of the original particle increases.
3. Both kinds of primary particles must produce other high speed particles (called secondaries) by collision with atoms in the air; but the facility with which they do this is different in the two kinds.

Crux of Theory

The crux of this theory is the way in which the secondary cosmic rays are treated. The existence of secondaries is a well-known fact. But heretofore they have constituted a sort of "mess" which obscured the real cosmic ray facts. According to Dr. Swann's view, however, they are practically the only thing anyone observes, and, more than that, they can serve to lead the experimenter back to those real facts which lie behind the scene.

Puzzling to physicists has been the scarcity of very high energy particles when cosmic rays were being watched in the Wilson cloud chamber. For it was known from experiments dealing with the effect of the earth's magnetic field that much of the incoming radiation must have energy greater than ten billion volts.

This paradox disappears in Dr. Swann's theory. Compared with the large number of lower energy secondaries, the high speed primaries are very rare indeed. They may be likened to an "unseen hand" which guides the be-

havior of the secondaries, and it is through the study of these locally generated particles that the true nature of the ones from outer space can be decided.

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PHYSIOLOGY

Dr. James Bertram Collip—Pituitary Governs Behavior

THE SMALL pituitary gland located in the head has more to do with man's behavior than any of the other glands, Dr. James Bertram Collip, professor of biochemistry at McGill University, told scientists at the Harvard Tercentenary celebration.

All of the glands have an important influence on behavior, but the pituitary, because of the way it affects each of the other glands and various other organs of the body, has the greatest effect. Dr. Collip explained how the glands and nervous system work together in man and higher animals. The glands themselves are influenced by the nervous system, but the chemicals they produce, known as hormones, may in turn affect the nervous system.

Scientific knowledge of the glands shows how widespread their influence on behavior is, but it does not justify some of the "fantastic" claims that have been made. Dr. Collip warned his hearers against overlooking basic principles in interpreting behavior on glandular grounds.

As an example of the way in which the pituitary gland affects behavior, Dr. Collip cited the case of a wolf-hound puppy studied in his laboratory. Soon after removal of this animal's pituitary gland, it was noted that the puppy, although belonging to a naturally aggressive stock, became extremely timid and stupid in his behavior, which was entirely different from that of a normal wolf-hound puppy. A few days after treatment with anterior pituitary extract, the animal's behavior changed markedly again, so that he became much more like the normal puppy of his breed. The change was so apparent that a worker in the laboratory, unaware that treatment had been started, commented on the unusual activity of the puppy and asked if anything had been done which might account for it.

Even more dramatic was the case Dr. Collip cited to show how more than one set of glands may similarly affect body mechanisms and behavior. This was the case of a man who had diabetes and was having insulin treatment. In

this condition it sometimes happens that too much insulin has been given, or not enough carbohydrate food is eaten. The patient then suffers from too little sugar in his blood, has convulsions and will become unconscious unless given some sugar or other carbohydrate at once.

The patient Dr. Collip described was walking down the street one day when he felt such an attack coming on and realized that he had forgotten to provide himself with a chocolate bar for the emergency. He went at once to a drug store and tried to explain to the druggist what he wanted. But by that time his gait was unsteady and his speech incoherent. The druggist thought he was a drunken man and threw him into the street. The patient became enraged at this treatment, promptly recovered, and was able to proceed to another drug store where he made known his wants, obtained what he needed and continued on his way.

In this case, Dr. Collip explained, another set of glands, the adrenals, became activated by anger and released enough of their hormone, adrenalin, to cause an increase of the patient's blood sugar sufficient to restore his equilibrium and powers of speech. The insulin-producing islets of Langerhans in the pancreas are the glands primarily concerned with control of the body's use of sugar, but the case of this patient shows how the adrenal glands also may affect sugar utilization and also behavior.

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PSYCHOLOGY

Prof. Charles Gustav Jung—Hunger Most Important

NOT sex alone, but five groups of instinctive factors were listed as the primary motivating forces of the mental behavior of man by Prof. Charles Gustav Jung, of the Technische Hochschule, Zurich, father of "Analytical Psychology," speaking before the scientists gathered at the Harvard Tercentenary Conference.

The instincts, with their compelling power over human behavior, are originally physiological phenomena, Prof. Jung holds, but they may become "psychified" by becoming important as determiners of mental behavior. First among these is hunger.

"No matter how unequivocal the physical state of irritation called hunger may be, the psychic consequences resulting from it can be manifold," Prof. Jung said. Hunger, he explained, can appear as denatured, or even as meta-

phorical. By combination with other factors, hunger can assume the most varied forms. Originally simple, it can appear transformed into pure greed, or into many aspects of boundless desire or insatiability, as for example, the lust for gain or inordinate ambition.

"Hunger, as the characteristic expression of the urge of self-preservation, is without doubt one of the primary and most powerful factors influencing behavior," declared Prof. Jung. "In fact, the lives of primitives are more affected by it and more powerfully, than by sexuality. At this level of existence, hunger means the alpha and omega—existence itself."

Sexuality, like hunger, undergoes a radical "psychification" Prof. Jung said. This makes it possible for the primary purely instinctive energy to be diverted into new channels.

Third among the instinctive factors controlling human behavior is the drive to activity. Under this grouping comes restlessness, love of change, wanderlust, and the play-instinct.

The urge for reflection was listed fourth among these instinctive groups by Prof. Jung. This means an interruption by mental processes to the otherwise automatic impulse-to-action circle. Thus, in place of the compulsive act, there appears a certain amount of freedom, and in place of the predictability a relative unpredictability as to the effect of the impulse, Prof. Jung explained.

Creative Urge

Finally, among these instinctive control groups, Prof. Jung places the creative urge, which is not precisely an instinct but closely allied with them.

"Like instinct it is compulsive, but it is not common, and it is not a fixed and invariably inherited organization. Therefore I prefer to designate the creative impulse as a psychic factor similar in nature to instinct, having indeed a very close relationship to the instincts, but without being identical with any one of them. Its connections with sexuality are a much discussed problem, and, furthermore, it has much in common with the activity-urge as well as with the reflection-urge. Still it can repress all of these instincts, or make them serve it to the point of the self-destruction of the individual. Creation is as much destruction as construction."

Besides these dynamic factors, human behavior is influenced by "modalities" including the age, sex, and hereditary disposition of the individual, which are semi-physiological but not, by any means, wholly so. Then there are three

others which are entirely psychological. First among these is the degree to which a person functions consciously or the extent to which he is dominated by compulsive instinctive processes. Next is the extent to which the individual is an extravert or introvert; the extent to which his life is directed outward toward other persons or material things or the extent to which it is turned inward toward his own feelings and experiences. Prof. Jung is the author of this extraversion-introversion conception.

"The third modality points, to use a metaphor, upward and downward, because it has to do with spirit and matter," Prof. Jung thus described the last of the "modalities." "From the existence of these two categories, ethical, esthetic, intellectual, social and religious systems of values eventuate, which on occasion determine how the dynamic factors in the psyche are to be finally used."

"Perhaps it would not be too much

to say, that the most crucial problems of the individual and of society turn upon the way the psyche functions towards spirit and matter."

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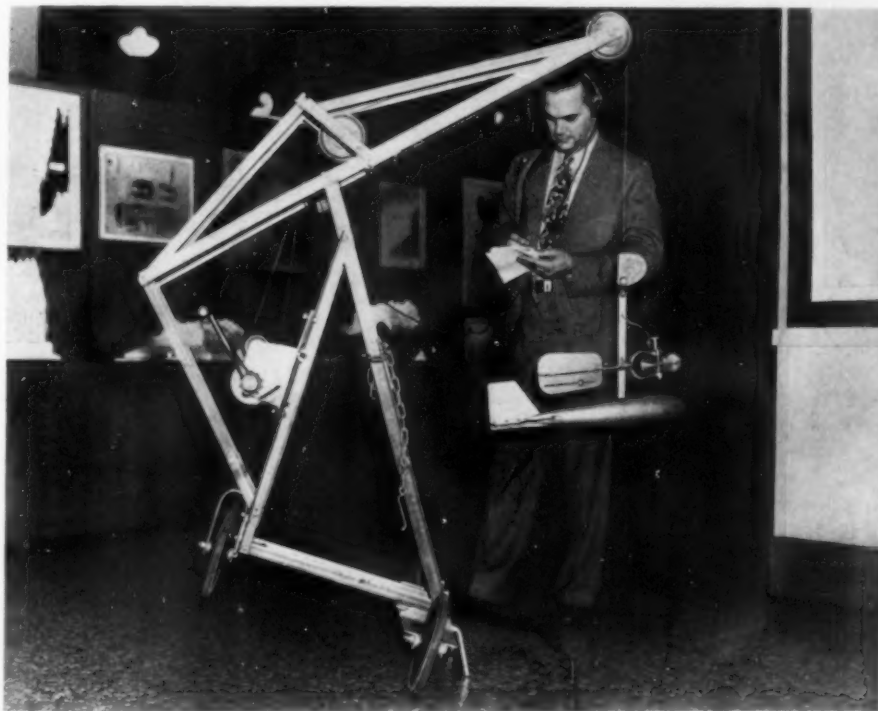
PSYCHOLOGY

Prof. Jean Piaget— A Moving Picture World

A GLIMPSE into the mental world of the baby and small child was afforded the scientists at the Harvard Tercentenary Celebration when Prof. Jean Piaget, professor of the history of scientific thought at the University of Geneva, described a child's way of thinking.

The little baby lives in a sort of moving picture world, Prof. Piaget's report indicated. He sees his surroundings as a series of pictures that have no permanence, no reality when they pass out of his sight. Almost to the end of his first

(Turn to page 174)



MEASURES FLOW

This object is neither a model seaplane nor a midget torpedo. It is the newest stream flow gaging apparatus on exhibit at the Third World Power Conference in Washington this week. J. G. Bloise, Puerto Rican expert of the Division of Water Utilization, Dept. of Interior, at Guayama, P. R., records the electrical clicks in his earphones as the ring of cups makes one revolution. The torpedo-shaped heavy base of the equipment points in the direction of current flow when placed in the water, while the whirling cups above measure the speed of the stream's flow. The small derrick on wheels rolls along a bridge, in actual use. To fix accurately the stream flow, scientists must not only know the contour of the bottom but also the speed of the current flow at many points so that the "volume" of water can be calculated.

CHEMISTRY

Powerful Antiseptics Made from Oat Hulls

OAT HULLS and other farm wastes may in future yield powerful antiseptics for use in medicine and for combating plant diseases, as they already supply industry with materials for making plastic products such as steering wheels, radio panels, and electric insulators.

Drs. N. M. Phatak and C. D. Leake, of the University of California Medical School, have combined furan, an oat-hull derivative, with mercury in various ways, producing a number of promising germ-killing compounds. In dilutions one part of antiseptic in from 15,000 to 30,000 parts of water, they killed test cultures of colon bacilli and the yellow germs that cause boils.

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PSYCHOLOGY

Children Laugh at Unusual Or Because They are Happy

A BUTTON is pulled loose from its place on a coat. That may be just an annoyance when it happens to you. But it is the signal for hilarious laughter in the kindergarten.

Children laugh at what is incongruous or unexpected, Dr. Grace E. Bird, professor of educational psychology at the Rhode Island College of Education, told the meeting of the American Psychological Association. They also laugh when they are happy.

Infants laugh, Dr. Bird said, when they are comfortable physically. The well baby is a happy baby and the happy baby laughs. At kindergarten age, laughter indicates not only physical but mental satisfaction. It is also a defense against the mental upset caused by the unusual occurrence.

Paint spilled for the first time caused amusement. Upsetting a chair is funny in the kindergarten unless it happens too often. Then it becomes commonplace. Children who had never before seen a dog chase its tail were hilarious over the performance.

Children laugh alone, although adults very seldom do. That is because laughing is not a social act with the young; it is with adults, Dr. Bird said.

"Often the mere fact that individual adults find themselves in one another's society is apt to create laughter, although their conversation may be commonplace

to the extent of dullness, with no attempt at wit or humor," she commented.

"In some cases this behavior may be a defense against inadequacy in conversation or social adjustment, just as a child's laughter may be a defense against the realization of a baffling or confusing situation which presents a problem to be solved. In most cases, however, this type of adult social laughter probably registers satisfaction or well-being."

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PHYSICS-MUSIC

Success Seen for Broadcast of Standard Pitch Note

THE broadcasting, by short wave radio, of a standard "A" 440 cycle musical note by the National Bureau of Standards has met with nation-wide interest, Dr. J. H. Dellinger, chief of the Bureau's Radio Division, told Science Service. (See SNL, Aug 15.)

One suggestion, governing future practice, points to the replacement of the musical gongs in broadcasting studios in giving time signals by this standard "A." Thus all interested persons would receive—without special short or all-wave radio receivers—the standard musical pitch.

While emphasizing that the idea was still merely a suggestion, Dr. Dellinger explained that the technical details of the plan did not appear to offer serious difficulties.

A simple way to solve the problem would be to have the National Bureau of Standards generate continuously the standard 440 cycle note in its radio laboratories and transfer it by wire to the Washington studios of the two nation-wide broadcasting chains.

The standard "A" would then be always available over the nation-wide wire circuits of the broadcasting companies. When time signals would be given on a radio program the announcer would merely press a button and give the standard "A" instead of striking a gong as is now done.

Commendation for the standard pitch service from musical instrument manufacturers and piano tuners' associations, plus the praise of orchestra leaders and individual artists, has already been received, Dr. Dellinger indicated.

The experimental standard "A" service was transmitted by the Bureau on the three short wave frequencies of 5,000, 10,000 and 15,000 kilocycles.

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IN SCIENCE

ETHNOLOGY

Peruvians Had Prayers Like Those in Psalms

PERUVIAN Indians of the ancient empire of the Incas recognized among their many deities at least one god who was all-knowing, all-powerful, all-ruling—a concept much like the white man's God, believed in and worshipped before the coming of the white man and his religious teachers.

Such appears to be a legitimate inference from two pre-Columbian prayers in the ancient Peruvian language, newly translated by Prof. Hermann Trimborn of the University of Madrid. Prof. Trimborn sent a brief report to the German scientific journal *Forschungen und Fortschritte* (June 10) shortly before the present civil war broke out in Spain.

The god was called Coniraya-Huirakocha, the double name apparently representing separate origins of belief in two distinct but parallel cults, just as the Hebrew Jehovah and the Mohammedan Allah are looked upon as the same God.

The two prayers addressed to this powerful deity have about them some suggestion of the tone of the Hebrew Psalms. One of them is a simple plea for assistance, before the undertaking of a hard task, like the weaving of a difficult pattern in cloth: "Inspire thou me in this: give thou me knowledge hereof!"

The other is longer, and more definitely theological: "Coniraya-Huirakocha, creator of mankind, creator of the earth; whatever is, is thine. Thine are thy fields, and for thee is thy mankind here!"

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HORTICULTURE

Gladioli, Once Scentless, Now Given Perfume

GLADIOLI, which add to their familiar beauty the charm of fragrant perfume, were introduced to the public at the flower show at Cornell University. A new double-flowered type of this flower was also exhibited for the first time.

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EE FIELDS

ZOOLOGY

Bounty on Coyote Pelts Found Racket in Montana

LAMPBLACK and grease turn harmless ground squirrels into "coyotes" for the purpose of collecting bounty, it has been reported to the U. S. Bureau of Biological Survey. The fake pelts, colored to collect reward, were detected by Montana officials assisted by R. E. Bateman, of Miles City, Mont., district agent for the Survey.

Collecting bounty has become quite a racket, Survey officials report. Those engaged in it will purposely release female coyotes from traps to insure a future "bounty crop."

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METEOROLOGY

Hurricane Weather to be Studied in Caribbean

WHAT is believed to be the first organized attempt to record meteorological conditions in the upper atmosphere during violent tropical hurricanes over the Caribbean Sea and southern states will be undertaken shortly by Massachusetts Institute of Technology scientists.

The storms are expected between the middle of August and late October and M.I.T.'s hurricane hunters have left Cambridge to find them.

With them they took 80 sounding balloons and specially constructed meteorographs which the balloons will carry miles into the air to record temperature, atmospheric pressure and humidity. Thirty will be equipped with tiny radio transmitters which will automatically send their readings to a base station at frequent intervals. The others will make their records on pieces of smoked glass and their data will not be known until the balloons burst in the rarefied air and fall to earth.

The expedition will be divided into two sections, one to operate in Cuba and the other in southern states in order to record the rapid changes in atmospheric conditions when the tropical storms curve inland from the Gulf of Mexico.

Delbar P. Keily and Douglas MacKiernan, Jr., will comprise the Cuban section. They will release only radio balloons, for instruments sent aloft here are not expected to be recovered. Christian Harmantas will operate in southern states releasing the smoked glass type balloons at Augusta, Ga., Montgomery, Ala., Jackson, Miss., and other southern points.

These balloons are expected to reach altitudes of from ten to fifteen miles before they burst and drop the shock-proofed instruments to earth. Each will carry an identification tag offering a reward for return to Technology, a system proved very successful in previous studies in other parts of the country.

The Cuban section, working with Father Eugolio Varquez of Belen College, will use two types of radio meteorographs: the Vaisala type developed by the head of Finland's weather service and the instrument developed by Charles F. Brooks and Karl O. Lange of Harvard's Blue Hill Observatory.

The receiving station for these miniature transmitters will automatically record the data of the hurricane swept skies.

Through the cooperation of the U. S. Weather Bureau and the special hurricane forecasting station at Jacksonville, Fla., the scientists will attempt to release the balloons before the storm, not only to record the changes when it strikes but to be sure they reach the upper air before being beaten to earth.

From the research meteorologists hope to extend present scanty knowledge on weather conditions, not so much during the fury of the storm but when it is approaching, to facilitate forecasting.

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CHEMISTRY

New German Enamel Has Valuable Properties

A NEW cellulose enamel is on the market in Germany under the tradename of "Emailliola" which is said to be insoluble in water, benzene, benzol, alcohol, turpentine and acetone according to the report of Trade Commissioner R. M. Stephenson at Berlin to the U. S. Department of Commerce. The material is highly resistant to weathering, acids, alkalis and mechanical rubbing. It is non-inflammable and can be applied to wood, paper, pulp, cellulose, metals, tile, stone, plaster and glass.

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PSYCHOLOGY

Boy Retains Impression of Words He Heard in Infancy

A MOTHER whispering loving nonsense to her baby may now feel sure that she is making a lasting impression on the infant's mind. Scientific evidence now confirms her belief that the lullabies and nursery rhymes heard by the infant make an impression on him that lasts until he is of high school age, even though he does not once hear them in the meantime.

Psychologists gathered at the meeting of the American Psychological Association heard the results of the tests on 14-year-old Benjamin P. Burt's ability to re-learn Greek poetry read to him when he was less than a year and a half old.

When Benjamin was just 15 months old, 3 twenty-line selections from Sophocles' "Oedipus Tyrannus," in the original Greek, were read to him once a day for three months. This material was the same to the baby as nonsense verse, his psychologist-father, Prof. Harold E. Burt, of Ohio State University, told the psychologists, just as it would be "all Greek" to most people, too. When Benjamin was 18 months old these selections were discontinued and three others read daily for another three months. This procedure was kept up with new selections each 3 months until Benjamin was 3 years old and he had heard 21 selections. Then the matter of Greek poetry was dropped until he was 8 years old.

Tests at that time of his ability to memorize these and other new selections revealed that the lines he had heard as a baby were much easier for him. Although the boy had no information as to which were the new selections and which the ones he had heard before, it was found that the relearning required 30 per cent fewer repetitions in the case of the familiar lines.

Now Benjamin is 14, and the tests of relearning have been repeated on selections not used in the tests when he was 8. The impression of these meaningless words heard in babyhood seems to have faded considerably now that the boy is approaching manhood, but it is still there. He learned the verses of his infancy in 8 per cent fewer repetitions than were required for the new material.

Benjamin is a very bright boy. His "I.Q." is 130 which puts him in the genius class, his intelligence being as high as that estimated for Balzac.

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METEOROLOGY

Long-Range Forecasting

**Present Predictions More Than 36 Hours Ahead
Seldom Go Wrong; Hope Is for Two-Week Forecasts**

By DR. FRANK THONE

WEATHER has long been synonymous, in the minds of mankind, with undependability. Changeable as an April day, wild as the wind, uncertain as rain in summer, unguessable as the weather—these and a thousand other like sayings reflect the popular feeling that of all things weather is most capricious, mutable, unstable, unpredictable.

But on that last word, unpredictable, science files a demurrer. The whole elaborate set-up of the Weather Bureaus of the United States and other lands, with their many hundreds of staff members and many thousands of unpaid volunteer cooperators, is predicated on man's ability to predict the weather, at least up to a certain point.

True, we all make jokes about the weather man's bad guesses. But do we not likewise make jokes about slip-ups on the part of doctors, preachers, professors and all other people who make their livings by more or less expert knowledge and skill? The whole point about jokes of this kind is that the professional man is usually right. If his slip-ups were more than merely occasional and exceptional, they wouldn't be jokes: if the doctor sent *all* his patients to the graveyard we'd chase him out of his profession—and we might hang him into the bargain. So the continued existence of the Weather Bureau after more than half a century of watching the weather, and its ever-increasing importance in aviation, commerce, agriculture and many other fields, is of itself an argument that the weather really is predictable.

36-Hour Forecasts

Present successful forecasts do not attempt to get much more than 36 hours ahead of the game. Sometimes the weather man has a pretty good idea what the weather will be like in 48 hours or more, but as a rule he is reluctant to be very specific about it; like all normal humans, he doesn't like to "stick out his neck" unnecessarily.

Yet it would be a tremendous advantage, measurable in terms of billions annually, if we could get at least a gen-

eral idea of the weather as much as two weeks ahead. Farmers would be able to plan for plowing and planting, merchants for shipping and selling, promoters for games and parades—in fact, practically every human activity could be far better ordered and organized than is now possible.

It is this as yet unsupplied demand for a longer foreknowledge of the weather that was responsible for the Farmers' Almanacks of long-past generations and that is still responsible for the innumerable unscientific long-range forecasters, all the way from local gaffers with goosebones (or rheumatism in their own bones) who take their pay in prestige only, down to outright commercial quacks who impress gullible businessmen with important-sounding pseudo-scientific language.

Is there any real hope of satisfying this age-old and very practical wish?

Will long-range weather forecasts ever be possible on a really sound and scientific basis?

There are many meteorologists, prominent in their profession, who are very conservative in their attitude. They will not declare dogmatically that "It can't be done;" for the world has lately seen too many impossible things become commonplace almost overnight to leave any safety in that position. But they are quite candidly very, very skeptical.

Facing these doubters, in the forums of scientific discussion, are other scientists who are at least willing to take a try at the business. Some of them have been at work on one lead or another for many years. But until recently no concerted effort has been made to get all ideas together and give them all a critical and impartial test.

Now at last it is to be undertaken by two Government agencies working in close cooperation—the U. S. Weather Bureau and the Smithsonian Institution. All ideas and suggested methods that look even a little promising are up for



HOME OF RESEARCH

Moonlight view of Smithsonian Institution, where sunlight's effects on earth's weather are under the scholarly scrutiny of Secretary Charles G. Abbot.



GETTING NEWS

Sending a small balloon aloft to explore the air masses above a mountain. Its movements are watched and plotted with the aid of the instruments (theodolites) on the tripods.

examination. It is fully expected that some, perhaps most, will not live up to first promises, and will therefore have to be discarded. But if even one or two methods in the end prove valid, the search will have paid for itself many times over. And if every one of them disappoints, at least it can be set down definitely that they all had their day in court.

This field day for long-range forecasting methods is to be carried through largely because of the strong personal interest of Henry A. Wallace, Secretary of Agriculture. A farmer himself, he has the farmer's direct and highly practical interest in the weather. A scientist also, he believes in trying things out—skeptical until good evidence is in hand, but open-minded to conviction if proof can be produced for even an unlikely idea. Finally, he has taken his own turn at the riddle of weather-making factors, in a statistical study made several years before he came to Washington to sit in the Cabinet of President Roosevelt.

Pool Information

In the search, he is well and ably seconded by the Chief of the Weather Bureau, Willis R. Gregg. Several of Mr. Gregg's colleagues in the Bureau have been devoting a good deal of time to the study of weather-making factors, and the organization offers good facilities for pooling their information and seeing what coordinations can be worked out.

At the same time, the Secretary of the Smithsonian Institution, Dr. Charles G. Abbot, has been given an appropriation of \$200,000 by Congress, to push further his studies of variations in solar radiation and their possible connection with weather changes on the earth.

Seven Paths

With this set-up, then, at least seven paths to possible success in long-range forecasting are to be explored. They are, in summary:

1. Total solar radiation
2. Ultraviolet radiation
3. Weather cycle studies
4. Weather correlation studies
5. Planetary position correlations
6. Ocean temperature correlations
7. Airmass analysis.

The first two are the care of Dr. Abbot and his colleagues of the Smithsonian Institution. The rest are being looked into by the U. S. Weather Bureau.

The study of solar radiation has been Dr. Abbot's companion day and night for a good many years. Like many other more distant lights in the heavens, our sun is a variable star, pouring out more light and heat at given times than it does at others. We do not notice this ourselves, because the total radiation is so great that we are insensitive to the relatively small percentage of the fluctuations.

But Dr. Abbot's studies have con-

vinced him that the earth's atmosphere as a whole is more sensitive to solar variations than are our eyes. Certain weather changes, he says, regularly follow increases in the sun's radiation as measured on the earth, and their opposite changes follow decreases.

The best places to set up the sensitive radiation-measuring instruments used in Dr. Abbot's studies are on the tops of desert mountains. For some years the Smithsonian Institution has maintained three such observatories, one at Table Mountain in California, one at Mt. Montezuma in Chile, and a third, more recently established, on Mt. Saint Catherine on the Sinai peninsula, between Egypt and the Holy Land. On a peak near this mountain—it might indeed have been on Mt. Saint Catherine itself—Moses received the Tables of the Law.

The new appropriation which the Smithsonian has received will make it possible to bring this chain of mountain-top observatories up to a total of ten. The sun will never set on Smithsonian observers, checking his every mood and variation and seeking hints therein for the solving of weather's ancient riddle.

Invisible Rays Variable

Dr. Abbot's long studies have disclosed one hitherto unsuspected fact: that the invisible ultraviolet rays vary a great deal more in intensity than do the visible rays. This lead is being followed up zealously, for several reasons. It is not known yet whether the weather changes are as closely correlated with ultraviolet variations as they are with variations in visible sunlight. But if they are, it is obviously easier to study their wider range than to measure the narrower shifts of the visible rays.

Also, it may greatly reduce the expense of studying solar variations, even possibly to doing away altogether with the costly remote observatories on desert mountaintops, where life is lonely and hard for the devoted little staffs of observers. For ultraviolet radiation can be recorded by small balloons sent up into the stratosphere, bearing light-weight automatic instruments to record photographically what they "see," or perhaps to transmit their "observations" by automatic radio back to the ground station. Experiments with such balloons and instruments are now on the Smithsonian schedule.

Weather cycle studies, one of the series of researches undertaken by the U. S. Weather Bureau, are based on the belief that the weather, unlike history, repeats itself. This is perhaps the favorite type of long-range weather study;

many workers in many lands have been at it for years. Some of them have claimed success in discovering cycles of returning weather of the same type, ranging from a few days to several centuries. J. B. Kincer, who has carried on a good deal of original investigation on his own account in this particular field, is directing the cycle investigation for the Weather Bureau.

Weather correlation studies are based on the obvious fact that weather does not come in separate pieces, like stones in a mosaic, but as a flowing continuity, like paints in a picture. Each kind of weather ties in with the neighboring kind, in a world-wide web of mutual influences. It has been claimed, especially by British scientists in India, that places far apart, like India and Australia, have definitely traceable connections with each other's weather. U. S. Weather Bureau scientists are also looking into this work, on which a considerable mass of data has been accumulated.

The planets are so remote from the earth that a connection between their positions and weather on the earth would at first seem downright fantastic—almost smacking of astrology. Yet when Henry Wallace and his colleague Larry Page some years ago made a statistical study, they found an apparent correlation between weather and the positions of the major planets, especially Jupiter. When Jupiter, earth and sun were all on or near the same straight line in space, certain conditions prevailed; when Jupiter was around on the opposite side of the sun, the weather was "opposite," too.

Planets Repel Spots

At the time, Mr. Wallace offered no positive explanation, except a suggestion of influence due to the gravitational pull of Jupiter, which is a thousand times as massive as the earth. But within the past few weeks Dr. Fernando Sanford of Palo Alto, Calif., has stated that three other planets, Mercury, Venus, and our own earth, apparently chase the sunspots around to the opposite side of the sun—and sunspots have persistently figured in all kinds of weather-influence studies. Dr. Sanford suggests that this sunspot-repelling effect may be due to like electrical charges on the sun and the planets. If this is true of these three planets, possibly the other planets may have a similar influence.

This planetary-influence hypothesis is still very much up in the air; for Messrs. Wallace and Page did not carry their investigation beyond the weather at one

station—Des Moines, Iowa—and the whole problem has been lying dormant for several years. Now, however, it is being dusted off and will have to go through the mill of re-examination, extension to other stations, and careful scientific criticism.

Ocean temperature correlations are also on the books for study. This work was pioneered in this country by Dr. George E. McEwen of the Scripps Institution of Oceanography, who for a number of years has based quite successful seasonal forecasts for southern California on the ocean temperatures off the coast during the summer months. The U. S. Weather Bureau has undertaken the same kind of studies for the Gulf and Caribbean areas, under the leadership of Giles Slocum. Steamship and airline companies are cooperating enthusiastically.

PSYCHOLOGY-PHYSIOLOGY

Hearing Apparatus Sets Own Limit on Pitch and Loudness

A NEW explanation of why hearing for deep tones falls off so rapidly as the pitch is decreased below the lowest notes of ordinary musical instruments was presented to scientists at the meeting of the American Psychological Association. Dr. Ernest Glen Wever and Dr. C. W. Bray, research team of Princeton University, famous for first "listening in" by telephone on the hearing apparatus of an animal, reported new findings from experiments conducted in collaboration with Dr. C. F. Willey.

Tapping the electric responses in the ear, this time of a guinea pig, the investigators studied what happened when tones of 5 to 60 cycles were sounded. The hearing of tones below 15 cycles is distorted; the overtones are greatly favored relative to the fundamental tone. It was also found that for these low tones there may be more than one volley of nerve impulses per cycle.

If, as these scientists have concluded from previous experiments, the perception of pitch, of low tones at least, depends upon the frequency of the volleys of nerve impulses, these extra volleys in the case of the low tones would make them appear higher in pitch and automatically place a lower limit upon perceived pitches.

The hearing apparatus also sets its

A final activity of the Weather Bureau that is already in full operation is air-mass analysis. This is a relatively new thing in weather forecasting, having been developed in Norway during the World War and adapted to American conditions since that time, notably at the Massachusetts Institute of Technology. The Weather Bureau has a key station for air-mass studies at Fairbanks, Alaska, where an airplane goes to a high altitude every day, carrying self-recording instruments under its wing. A second station exists at Fargo, N.D., and the Canadian government has arranged for cooperation at a station in between these two, at Fort Smith on the Mackenzie river. Eventually, too, the chain may be extended into Siberia, through cooperation with the Soviet Government.

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own limit upon the loudness of sounds which it is possible to perceive, it appears from this same investigation. The results show that for any given tone, the maximum response of the ear's cochlea may be reached at an intensity below that which causes any harm to the ear. It is not pain or actual damage to the ear that sets the limit to the intensity of sounds that we can "take in;" that limit is set by the mechanism of hearing itself, the investigators concluded.

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ASTRONOMY

Model of Moon Displayed At the Franklin Institute

See Front Cover

LENDING charm to the scientific model of the moon built by her father, little five-months-old Verne Carlin Spitz posed as the "Baby in the Moon" for the photograph on the front cover of this week's SCIENCE NEWS LETTER.

The model, constructed by Armand N. Spitz of Newtown Square, Pa., is intended to show the phases of the moon as seen through a powerful telescope. It will be demonstrated during this month at Franklin Institute.

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COTTON NOW GOES INTO ROADS

As an extra safeguard against "washboard" roads on secondary highways and airport runways, layers of cotton sheeting are now used in the base construction. Shown above are workmen laying a "cotton" road near Birmingham, Ala.

CHEMISTRY

Scientists Hope to Separate Gas Isotopes By Whirling

THE once-abandoned hope of physical science to separate the isotopes of a gas by whirling the chemically inseparable parts in a centrifuge is to be revived once more in new experiments at the University of Virginia.

Isotopes are the two or more varieties of a chemical element which are found to have slightly different masses although considered the same element. Thus there are two kinds of argon, two kinds of lithium, three kinds of oxygen and so on. Chemical methods will not separate them while physical methods will accomplish separation only in some cases, and then only with the utmost technical difficulty.

Prof. J. W. Beams and F. B. Haynes, assistant professor, report to the Editor of the *Physical Review* (Sept. 1), journal of the American Physical Society, that their new air-driven centrifuge, which has potential speeds of nearly 1,800 miles an hour, is so much more powerful than any similar device previously tried that the long-sought goal of science is at least worth one more attempt.

Some Need Less Speed

The separation of some isotopes, it appears from calculations, should be ac-

complished at only half the speed which their ultra-centrifuge should attain.

The idea of centrifuging two gases to separate them was tried early in isotope research for it appeared possible to obtain the two fractions of different weights by whirling them, just as one can separate cream and milk in a cream separator.

Inherent in the new research program, which will have the greatest possible benefit to science if successful, is the development of a centrifuge rotor which will spin freely in the penetrating cold of liquid air temperatures at minus 192 degrees below zero centigrade. Operation in even lower temperature is anticipated, report Profs. Beams and Haynes.

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● RADIO

September 15, 2:15 p.m., E.S.T.
STARRING A DINOSAUR—Charles W. Gilmore of the U. S. National Museum.

September 22, 2:15 p.m., E.S.T.
NEW FACTS ABOUT FEET—Dr. Dudley J. Morton of Columbia University.

In the Science Service series of radio discussions led by Watson Davis, Director, over the Columbia Broadcasting System.

ENGINEERING

Cotton Roads of the South Are New Crop Outlet

DOWN in Alabama recently dusky cotton pickers, pulling long cotton sacks bulging with the fleecy staple, paused long enough at the end of their rows to watch highway construction near-by. Their attention was attracted by the laying of a canvas-like material between the layers of sand, slag and asphalt.

The Negro farm hands didn't know it, but the same substance they were picking, except in different form, was being used to build up the road. No one took the trouble to tell them, but they were seeing history in the making. Now traffic is moving over this first "Cotton Highway," a small part of an extended program being fostered by the U. S. Department of Agriculture in which some 6,167,000 square yards of cotton fabric are being provided for the building of over 500 miles of roads in 24 states.

Advocates of "cotton paving" contend that it not only reinforces the bituminous surfacing of the highway, but also prevents it from cracking and improves its resistance to water. In a broader sense it is hoped that a great new domestic market will be provided for the chief product of the southern farm.

But the cotton fabric must prove its case before being widely used in highway construction. Six bales of cotton per mile are required for the usual

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"farm to market" highway and its use increases construction costs about \$1,000 per mile. A year or more will be required for an adequate test.

The rolls of cotton fabric as they come from the mill are 82 inches wide, three rolls being required after allowing for lapping to cover 20 feet of the usual 22-foot roadway. It is laid on a coating of hot tar, then more tar applied, with other layers of slag and asphalt coming on top.

Alabama proposes to build 119 miles of cotton fabric highways using 1,260,094 square yards of the material or more than any other state. North Carolina comes next with plans for 105 miles. Twenty-two other states will use varying amounts.

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year he behaves as though when objects disappeared from his field of perception, they simply ceased to be.

"Between the ages of five and eight months," said Prof. Piaget, "when the child already knows well enough to seize any solid objects which he sees, one has only to cover them with a cloth, or place a screen in front of them at the moment when the baby's hand is directed towards them, and he will give up looking for them, and immediately lose his interest.

"I have even observed this in systematically hiding the bottle when my six-months-old son was about to take it.

"But one can see a still more curious reaction around nine or ten months, when the child is capable of seeking the object behind the screen, and the no-

tion of real exterior permanence begins to put in an appearance. For example, when the baby is placed between two pillows and he has succeeded in finding an object hidden under the right one, the object can be taken from his hands and placed under the left pillow before his very eyes, but he will look for it under the right pillow where he has already found it once before, as if the permanence of the objective was connected with the success of the former action, and not with a system of external displacements in space."

In short, Prof. Piaget summed up, the primitive world of the child is not made up of permanent objects, but of moving pictures which return periodically into non-existence and come back again as the result of the proper action.

The baby, in handling his toy will turn it until he finally gets a notion of a "wrong side" of objects. But this does not come right away. Hand a five or six months old baby his bottle and turn it around before his eyes. If the child can see a bit of the rubber nipple at the other end of the bottle, he immediately turns the bottle around, Prof. Piaget explained. If he doesn't see the nipple, he doesn't even attempt to turn it, but sucks the wrong end.

When at last the baby has built up a more correct idea of the world and the objects about him, he has still to master the problem of perspective. Even the child of five or six will feel that a mountain changes in size as he approaches it. Prof. Piaget has noted this in travelling with his own little children among the mountains of his home land.

Finally comes the problem of comprehending the perspective of other in-

dividuals. Right and left to the young child are absolute; he cannot realize that what is right to him might be left to another. Then he must get the idea of the permanence of quantity; that a row of ten beads, for example, remains just ten even though they are placed in a longer row or gathered up into a heap. And the permanence of weight, that a paste ball is just as heavy when it is squeezed out into a cylindrical shape. This development of the thought of the child parallels in a way the development of science.

"The effort by which the child escapes from his egocentricity to form a world with this social and rational instrument which the logic of relationships gives him," concluded Prof. Piaget, "is at the basis of the ever-present gigantic effort of science to free man from himself by making him realize objectively the relativity of all things."

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PHYSICS-PHYSIOLOGY

Eye Can See One Millionth of an Inch

NEXT time you see a film of oil on a rain puddle in the pavement look for the colored light fringes. Pretty? Yes. But, more important, they indicate that your eye can detect a difference of one-millionth of an inch. That is the thickness of the oil films which produce those colors by interference. The beautiful coloring of some butterfly wings is a similar phenomenon of thin films. The best micrometer gages now in use will detect differences of only one thousandth of an inch.

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None Spared

THE elm disease now being fought in the region around New York City is very different from the equally terrible plague that succeeded in wiping out another one of America's finest hardwood species, the chestnut!

Chestnut blight was quite selective in its action. It attacked only the American species of chestnut tree. Chestnuts from Europe and Asia are quite resistant; indeed, new kinds of chestnut to replace our vanished native trees were sought by the U. S. Department of Agriculture in Japan and China.

The elm disease, on the other hand, appears to attack practically every species of elm—the American or white elm, slippery elm, cork elm and the European elm which has been planted extensively as an ornamental. As a matter of fact, it seems to have been even more virulent against the European elm than against our native species; it was in shipments of European elm logs for American veneer factories that the fatal fungus slipped into this country.

One elm type only seems to be more or less resistant to it—the elms of eastern Asia. Even these are not immune, but only tolerant of the fungus: they can harbor it and still live. For this reason it is conjectured that the elm disease originated in Asia.

Wherever it came from, there is no doubt that its commonly accepted name, Dutch elm disease, is an injustice to the Netherlands. The disease was first recognized in that country, to be sure, but it did not exist there prior to the World War, so far as is known. However, by 1919 it had spread over a great part of Europe, necessitating the destruction of many fine street and park plantings of elms.

The elm disease is unlike the chestnut blight also in the thoroughness of its effects. Once an elm has died of it, it is totally and permanently dead. But killed chestnuts died only down to their roots, and young sprouts have continued to come up. Some of these are now beginning to bear a few nuts. These young coppice-trees are being watched very carefully by tree-growers. Will they supply us with the long-sought blight-immune chestnuts, or will the blight strike them down presently? Nobody knows as yet.

PSYCHIATRY-PSYCHOLOGY

"Unconscious" Emotion Is Revealed By New Technique

Psychogalvanometer Betrays Excitement of Subjects Who Were Not Aware of Feeling Any Apprehension

A NEW technique for detecting emotion through measurement of electric resistance of the skin was reported to the American Psychological Association. Possible use of this new test in exploring the unconscious minds of the mentally ill was suggested by the results of experiments reported by Dr. T. W. Forbes, of the New York State Psychiatric Institute and Hospital.

Sometimes known as the "lie detector," the psychogalvanometer—used to record the physical changes that occur when a person is questioned about his guilt or when his emotions are aroused in any other way—has previously been incorrectly used, Dr. Forbes indicated. The electrodes have customarily been applied to two separate skin areas. By reading potentials from just a single skin area, Dr. Forbes found not one but two waves which were confused or masked in the readings from two areas.

One wave is negative and the other positive, and both occur with great regularity in most individuals. The "a," or negative, wave showed little variation in amplitude and occurred whether the subject was excited or not.

Positive Wave Varies

The positive "b" wave, on the other hand, occurred with increased magnitude whenever the subject was excited. This was true whether the "exciting" situation involved electric shock, the startle of a revolver shot, or words designed to be embarrassing.

Another dissimilarity exists in the manner of spreading of the two disease fungi. The blight fungus went directly from tree to tree, but the elm disease fungus cannot do that. It must be carried by a bark-boring beetle. But there are plenty of the beetles, so this critical link in the life cycle of the elm fungus is not really a weak link. The only known way of driving the elm disease off this continent again is the total destruction of every tree found harboring it.

Science News Letter, September 12, 1936

The "lie detector" technique would not be equally effective on all individuals for the purpose of detecting their emotional responses, Dr. Forbes' experiments indicated. Some individuals, he reported, failed to show any change of the "b" wave except with very intense startle.

May Aid Psychiatrist

The possibility that this technique may prove of value in investigating unconscious responses in the mentally ill was suggested by the finding that the "b" wave sometimes occurred when the subject was completely unaware of any feeling of embarrassment, but when the situation contained the possibility of that effect. It also occurred when the subject knew that he might receive an electric shock, even though he was not conscious of feeling any apprehension.

Science News Letter, September 12, 1936

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Biography

BRITISH MASTERS OF MEDICINE—Sir D'Arcy Power, Editor—*Waverly Press*, 242 p., \$3. A valuable contribution to the history of medicine containing biographies of two dozen British leaders in medicine from the time of Harvey to the present, each written by those who have been attached to the great institutions which these heroes of medicine made famous.

Science News Letter, September 12, 1936

Aeronautics

HEROES OF THE AIR—Chelsea Fraser—*Thomas Y. Crowell*, 750 p., \$2.50. A new edition of a popular history of modern aeronautics particularly since the World War.

Science News Letter, September 12, 1936

Physics

A TEXTBOOK OF PHYSICS—Charles A. Culver—*Macmillan*, 816 p., \$4. A text for a comprehensive year's course in general physics for students of engineering and science, by the professor of physics in Carleton College.

Science News Letter, September 12, 1936

General Science

FRONTIERS OF SCIENCE—Carl T. Chase—*Van Nostrand*, 352 p., \$3.75. The reader is taken into those areas of science where the unknown is being turned into the known. Sections are devoted to the Frontiers of Time and Space, The Quest for the Ultimate, The New Age of Chemistry, The Frontiers of Health, The Secret of Life.

Science News Letter, September 12, 1936

Hygiene

SEX AND THE LOVE IMPULSE—J. H. Burns—*Emerson Books*, 61 p., 50c. Correction of listing in *SCIENCE NEWS LETTER* of July 25, 1936.

Science News Letter, September 12, 1936

Hydrodynamics

SILTING OF RESERVOIRS—Henry M. Eakin—*Govt. Print. Off.*, 142 p., 40c. U. S. Dept. of Agr. Technical Bull. no. 524.

Science News Letter, September 12, 1936

Chemistry

THE PHENOMENA OF POLYMERISATION AND CONDENSATION—General Discussion held by The Faraday Society—*Gurney and Jackson, London*, 412 p., 22s. 6d. +10d postage. A general, comprehensive and international discussion

of an important field of chemistry done in the manner for which the Faraday Society is famous. Contributions and discussions by fifty scientists are included.

Science News Letter, September 12, 1936

Marine Zoology

SCIENTIFIC RESULTS OF THE WORLD CRUISE OF THE YACHT "ALVA," 1931, William K. Vanderbilt, Commanding—Lee Boone—Privately printed, \$5. This volume covers Crustacea, from Anomura to Amphipoda, and the Asteroidea and Echinoidea among the Echinodermata. The illustrations include both halftones and well-drawn line cuts. The book is part of a series of interest primarily to systematic zoologists.

Science News Letter, September 12, 1936

Conservation

NATURE PROTECTION IN THE NETHERLANDS INDIES—*American Committee for International Wild Life Protection*, 73 p., 50c. Even in the tropics it is now necessary to take considerable thought for the welfare of wild animals. This brief publication contains much information not hitherto easily available, on what is being done in one important faunal center.

Science News Letter, September 12, 1936

Mathematics

BIBLIOGRAPHY OF EARLY AMERICAN TEXTBOOKS ON ALGEBRA—Lao Geneva Simons—*Scripta Mathematica*, 68 p., \$1. A key to one phase of mathematical beginnings in America. First editions through 1850 are listed.

Science News Letter, September 12, 1936

Medicine

PHYSICIAN, PASTOR AND PATIENT—George W. Jacoby—*Paul B. Hoeber, Inc.*, 390 p., \$3.50. A useful and interesting presentation of the relation existing between medicine and religion. The author is Past-President of the American Neurological Association and out of his experience as practitioner and teacher he discusses birth control, suicide, divorce, criminals, sterilization, euthanasia, professional secrecy and other questions.

Science News Letter, September 12, 1936

Economics

GUINEA PIGS NO MORE—J. B. Matthews—*Covici, Friede*, 311 p., \$2. A plea for a consumers' society as an alternative to the regency of business and as an alternative to a workers' state. A Federal Department of the Consumer is advocated.

Science News Letter, September 12, 1936

Physics

UNIFIED PHYSICS—Gustav L. Fletcher, Irving Mosbacher and Sidney Lehman—*McGraw-Hill*, 662 p., \$1.80. A high school text in which the authors, who are New York City high school teachers, treat physics as the science of matter in motion instead of dividing it into the traditional mechanics, heat, sound, light, and electricity.

Science News Letter, September 12, 1936

Physics

PERSPECTIVE AND OPTICAL ILLUSIONS OF DEPTH—Theodore M. Edison—*Calibron Products, Inc.*, 44 p., 50c. (Calibron Notebook, No. 3.) Useful and illuminating with striking illustrations.

Science News Letter, September 12, 1936

Hygiene

SEX EDUCATION—Maurice A. Bigelow—*American Social Hygiene Assoc.*, 307 p., \$1. Primarily for general readers, especially parents, teachers, ministers, and students, this is a revised edition of a book successfully used for twenty years. It presents the educational problems and philosophy of the social hygiene movement in America today.

Science News Letter, September 12, 1936

Physical Chemistry

UN NOUVEAU CORPS SIMPLE; LE DEUTERIUM OU HYDROGENE LOURD—E. Darmois—*Hermann & Cie, Paris*, 41 p., 10fr. A review of research on deuterium and heavy water with a comprehensive bibliography.

Science News Letter, September 12, 1936

Photography

NATURAL COLOR PROCESS—Carlton E. Dunn—*Amerian Photographic*, 194 p., \$2. A concise outline of the available methods of color photography with practical instructions.

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